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Improved Seasonal Predictability of Droughts by Conditioning the Prediction on ENSO

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We examine the skill of predicting meteorological droughts two to four months in advance with a 10-member hindcast ensemble of the Max Planck Institute Earth System Model (MPI-ESM) seasonal prediction system initialized every May and November between 1982-2013. Since the hindcast evaluation is only possible if drought conditions are classified identically for observations and model predictions, we first establish the most appropriate drought index, and test different probability density functions with varying fitting procedures. Depending on the normality of the drought indices, we identify the most appropriate index to evaluate the hindcast ensemble against observations.

The standardized precipitation index (SPI) outperforms other alternatives if it employs a generalized gamma distribution whose parameters are derived by brute force. These parameters are then optimized with a Monte Carlo (simulated annealing), a quasi-Newton (L-BFGS-B) and a downhill simplex (Nelder-Mead) method. In order to quantify hindcast skill for particular SPI classes we use the ranked probability score and find – in line with previous studies – the overall seasonal predictability of droughts similar to that of climatology. However, we show that conditioning the hindcast skill analysis on the ENSO-state at the beginning of the hindcast leads to significantly better results than climatology, in particular in regions that have known strong ENSO teleconnections. Winter drought hindcast skill outperforms climatological hindcast skill for example along the east coast of South America, southern US, and Western Australia. Summer drought hindcast skill is high for droughts in eastern Australia and South America.